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Discussion of the paper "STABILITY OF ELASTO-PLASTIC WIDE-FLANGE COLUMNS" by G. F. Hauk and S-L. Lee.

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Discussion by M. G. Lay[#], A.M. ASCE and T. V. Galambos[##], M. ASCE

It is surprising to note that no mention has been made in this paper of the work of M. Ojalvo and others[D1,D2,D3,D4] in which the same problem had been previously solved. For instance, Figs. 5 and 6 have been given by Ojalvo[D1] in a more extensive form. Ojalvo's work has since been applied to the design of elasto-plastic structures[D2,D3,D6,D7]. The curves which the authors give in Fig. 5 have been called column deflection curves in the relevant literature.

Perhaps the omission of the column deflection curve work is due to the authors' philosophy expressed in their statement with regard to Ellis' solution[16] (which is similar to Ojalvo's[D1])

> ". . . . but had to resort to numerical methods of integration and was therefore, forced to use tabulated values of the curvature as a function of moment and axial force."

In an era of high speed computation, the writers do not believe that one is "forced" to use numerical methods or made to "resort" to tabulated data inputs. Using the method of reference D1 or D4 it is possible to closely represent the real situation. The numerical solution requires a relatively short program, and computing time for one of the curves in Fig. 5b is less than 60 sec.

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On the other hand, the authors have presented a type of closed solution by algebraic manipulations of an analytical model which only approximated the real situation and neglected a number of significant factors (such as residual strains). The derivation and solution of the authors' equations are lengthy and involved, in fact they suggest that a computer be used to facilitate the final solution.

It might also be noted that the basic differential equation being solved will only yield closed solutions for a very limited number of moment curvature relations. The authors are fortunate that the particular model that they have chosen produces one such relationship.

As a final point, the writers wish to comment on the fact that the authors' statement of beam-column stability is restrictive.

Their statement that after $\partial m / \partial mf = 0$ (Eq. 110) is reached

> ". . . . further points along the -(deformation)- path represent unstable equilibrium."

is only true in the particular case where the applied moment (M in Fig. 4) also satisfies

$$\frac{\partial M}{\partial m_f} = 0 \tag{D1}$$

when Eq. 110 holds. Generally, Eq. 110 will not be true as the loads P and M will be transmitted to the beam-column by adjoining beams and columns. In such a case P and M will be functions of the deformations at the end of the beam column. Instability will occur when

$$\frac{\partial m}{\partial mf} + \frac{\partial M}{\partial mf} \cdot \frac{1}{M_{pc}} = 0 \tag{D2}$$

It is meaningless to speak of the stability or otherwise of an individual member unless the deformation response of its applied loads has also been specified. This point is very relevant to the present paper as an important application of the column deflection curve work is in the utilization of beam-columns beyond the point at which Eq. 110 holds. Examples of this are given in references D2, D3, D5, D6, D7, and D8. The writers have recently conducted tests[D8], which have verified the stable nature of the region which the authors consider to be unstable.[D8]

References

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